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APPARENT CONTROL OF THE POSITION OF THE VISUAL FIELD.

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One of my students reported that she possessed the ability of moving upwards the entire visual field. This translocation first occurred involuntarily and after noticing the phenomenon the subject found by trial that it could be repeated at will.

During several conferences and tests the following account was obtained, giving the essential facts as to the nature of the phenomenon and the circumstances of its occurrence so far as the subject had been able to notice them: The subject is afflicted with hysteria. A rather severe attack occurred seven years ago from which she is slowly recovering. The involuntary translocations were first noted shortly after this time and they have occurred rather infrequently ever since. Fatigue and a prolonged fixation seem to be the conditions under which they occur involuntarily. The phenomenon can be produced voluntarily at any time and under any circumstances. The subject has refrained from much experimentation for fear of aggravating her mental condition. An object is momentarily fixated and then slowly raised upwards. The duration of fixation necessary before movement can be effected varies from one to ten seconds. The rapidity of the movement varies. The translocation is sometimes slow and gradual and is effected only by continuous effort; at other times the movement is more rapid and comes easily. Fatigue and brightness of the visual field decrease the time of necessary fixation and increase the rapidity and ease of the translocation. The extent and duration

of the displacement is under complete control. The extent of the movement may be anywhere from one to forty degrees. The field may be held stationary at any desired position, and then be moved on upwards or be brought back to its original position. The displacement has been maintained in one position for five minutes, though the continuous strain necessary is very fatiguing. The exhaustion due to continuous effort seems to be the only limitation of the possible duration of the phenomenon. Objects do not become double during the translocation; they are perceived only in their elevated position, although the subject is conscious of their original location, for she can at any time point accurately in that direction. The entire visual field participates in the movement, and all visual objects keep their relative positions to each other. The only noticeable change in the character of the visual objects is a slight decrease in their intensity, though they remain distinct and substantial in appearance. When the field is lowered to its original position, the visual objects receive an added snap of reality the moment they reach their real position. It is by this means that the subject knows when the objects reach their true positions. Both the upward and the return movements are consciously real; objects do not merely appear now in one place and now in another, but they appear to move as well. The objects do not move relatively to the line of sight. The object originally fixated remains at the point of fixation throughout the displacement; in other words the point of fixation participates in the translocatory movement. The visual field remains perpendicular to the line of sight, as if it were undergoing a vertical rotation about the head as a center. If a person is in the visual field his voice participates in the illusion. In the preliminary tests, the subject was requested to attempt other directions of movement but she was unsuccessful. Moreover, she was successful only with binocular vision, and when the eyes were in relatively unconstrained positions in the socket during the original fixation. With monocular vision or when the eyes were rotated far to the periphery, only a very slight and momentary displacement could be effected.

At first it was supposed that the phenomenon could be explained on the basis of one of three theories: (1) The trans-

location is effected by some ocular innervation which does not involve eye movement, but which shifts the space reference of the retinæ. The phenomenon would thus be similar to the well-known illusion due to the paralysis of the external rectus. This theory was put out of consideration immediately by the very obvious fact that the eyes do not remain stationary, but rotate in the direction of, and in proportion to, the visual illusion. If the illusion were slight in extent one could not be certain of this fact, but a movement of thirty degrees that may be maintained for five minutes is too obvious for the most sceptical observer. The subject was asked to point out the apparent location of the fixated object, and it always coincided with the directional position of her eyes. (2) The second theory supposes that the eyes rotate with the illusion, the space reference of the retinæ remains normal, but that a refractive change, a lateral or rotary movement of the lens, occurs whereby the rays from the real positions of the objects are kept focused upon the same points of the retinæ in spite of the bulbular or retinal rotation. Such a conception is conceivable though its truth is not probable according to current views of ocular physiology. There is some factual support for such a theory, because the point of fixation, that portion of the field corresponding to foveal activity, is displaced and the image of the object originally fixated is still located at the point of fixation. Foveal positive and negative after-images were induced and developed before the translocation. These after-images representing foveal activity participated in the movement and were still located at the point of fixation. Although the eye has rotated upwards forty degrees away from the object primarily fixated, yet the image of that object must be due to the foveal activity of the retinæ, for it is located at the fixation point and also at the same position in space as a foveal after-image. This theory was tested by making a phakoscopic examination of the behavior of the refractive surfaces. No unusual movements were detected. The lenticular images behaved in reference to the corneal image exactly as they did during a similar normal rotation. No refractive changes were in evidence. Ophthalmoscopic tests were planned but a more satisfactory theory was evolved before they were carried out.

(3) It may be supposed that the illusion is due to some disturbance in the sense of bodily position, which illusory disturbance is projected upon, or interpreted as belonging to, the objective field, the inverse of the haunted swing illusion, etc. There is no evidence in favor of this theory. The subject does not feel dizzy in the least. Her conceptual, or ideational, space is not affected; she can point out the vertical and cardinal positions, and the real location of the displaced objects although she may not see anything in that direction. Furthermore, if the theory were true, it would be necessary to assume some secondary principle, as a refractive change, in order to compensate for the effects of the eye rotation.

The next conception evolved to be experimentally tested may be roughly stated as follows: During the entire period of the displacement, the retinæ are insensitive to all objective stimulations, and that which the subject sees is a hallucinatory positive after-image of the objects primarily perceived. This theory was suggested by two facts: (1) The subject is an hysteric, a temporary visual anæsthesia being one of the symptoms; (2) In the preliminary tests I noted that she was extraordinarily susceptible to positive after-images. A momentary glance at an electric light in daylight is sufficient to induce a positive after-image with a duration of seven to eight minutes. This conception proved to be true in the main. The tests were made at various times of the day with different conditions of illumination. Two series were made at night in a room illumined by a shaded Welsbach lamp. The remaining tests were made on bright clear days in a well-lighted room where the brightness of the background could be varied. The various experiments will be grouped around a series of propositions.

A. *The translocations may be in any direction and may be initiated and sustained by a movement of either the eyes, head, or body.*

At first the movements had occurred in but the one direction; at my suggestion the subject attempted other directions of movement but was unsuccessful. If the translocated visual field is a positive after-image, it would seem that any direction of movement should be possible. With this idea in mind, the subject

was directed to rotate her head slowly sidewise during an upward displacement. She did so and the displaced field moved likewise. The field could now be moved in any direction by either a head or eye movement. After this experience, the subject was able to start the displacement in any direction, the preliminary upward movement not being necessary. By turning the head and body, the field may be rotated to such an extent that the objects originally perceived no longer stimulate the retina. This result did not occur with the first displacements of forty degrees. The field may be rotated the full 360 degrees if desired.

During the preliminary tests, displacements could not be effected with monocular vision, nor when the eyes were in constrained positions. After several months of experimentation, the attempt to secure displacements under these conditions was repeated with successful results. The translocation was effected, but not readily, and the period of necessary fixation was longer than in the case of binocular vision with a normal position of the eyes.

B. *All new objects introduced into the field of vision during the displacement are not perceived.*

This statement does not mean that the stimulations do not affect vision at all; it means that these objects are not perceived as objects with their proper form, color and position so as to be recognized and located in space. At first the subject was kept in ignorance of the nature of the tests, and while she occasionally knew that something had happened to the visual field, she did not have the least idea as to what had caused the perceived changes. After being informed as to the nature of the experiments, she generally knew that some object had been introduced into the visual field but she had no idea as to its nature or location.

At night, she fixated a lighted candle near the wall some eight feet distant. After a displacement of fifteen degrees, a large bright yellow paper was thrust in front of the candle; it was not perceived. The paper was now put eight inches in front of each eye in succession, and then held at the same distance in front of both eyes for a couple of minutes. The paper

was large enough (16 in. square) to intercept the entire visual field, and a Welsbach light was so situated as to shine directly upon it. In neither case was the paper seen. A long series of similar tests was performed in bright daylight, the objects being introduced at different distances from the eye and in various positions in the visual field. A few typical cases will be described: After a twenty degree displacement, a book and a lighted candle were placed at the original fixation position. The lighted candle was moved back and forth a foot in front of her eyes. A bright paper screen was placed a foot in front of both eyes so as to intercept the entire visual field. The screen was kept in this position for two minutes. Again, the field was displaced so that the subject's eyes were directed at an electric light some eight feet distant. This light consisted of three sixteen-candle incandescents. While the eyes were held in this position, the light was turned on for fifteen seconds. This test was repeated a dozen times. In one of the tests the light was kept on for a full three minutes. In none of these cases were the objects perceived. When the visual field is moved more than ninety degrees, it is projected against an entirely new background of objects and these always remain invisible.

C. *Objects introduced into the visual field during the displacement, although not perceived, may affect the brightness, color tone and distance location of the displaced images.*

The effect varies with the brightness of the field originally fixated, and the intensity, extent, and duration of the stimulation introduced. If the objects displaced be very bright, while the stimulation introduced be of small extent or of weak intensity, no effect is noticeable. If the field be weak in intensity, and the stimulation introduced be intense, large and prolonged, a maximum effect results.

When the window was displaced in bright daylight and a book or lighted candle was placed at the original fixation position at a distance of ten feet from the subject, no effect was noticed. When the screen of bright yellow paper was passed close in front of her eyes so as to intercept the vision of one or of both eyes, a very dim shadow appeared to pass over the distant displaced field. When the lighted candle was thrust close

in front of her eyes, a marked pupillary reflex was evident, and a very dim pale yellow light was suffused over the distant field. The bright window and a dull yellow wall were successively displaced in the direction of the electric lights; this stimulation produced a pale yellow glare over the field, but the effect was much more pronounced in the latter case, *i. e.*, with the less intense field. When the image of the window was displaced against the electric light, no effect was noticeable at first; after a few moments the yellow light tinged the field and gradually became more intense as the stimulation was prolonged. After a few minutes the yellow glare contracted from the periphery and became concentrated in the center of the field. Probably in time the lights would have been perceived in this case, but the subject was not able to prolong the test over three minutes. A dull wall was displaced against a blackboard as a background at the distance of three feet from the observer. A lighted candle was held near the blackboard and directly in front of her eyes. At first there appeared a dim flare of yellow light which gradually contracted in size and increased in intensity. After four minutes the image of this candle broke through the displaced field and was perceived as a candle. This was the only case in all of the tests where a distinct perception of the object occurred, and even here the percept of the candle was described as being strange, hazy, and unreal in appearance, and much less intense than in ordinary vision. Furthermore, in this test the field had been rotated more than ninety degrees, so that the objects primarily fixated no longer stimulated the retinæ, and, as shall be noted later, the stimulation from the real objects is effective in maintaining their displaced images in consciousness.

When the screen was placed close before both eyes so as to intercept the entire visual field, some of the displaced visual objects, after some time, appeared located at the distance of the screen as though projected upon it. The screen remained invisible and the subject was ignorant as to the nature of the experiment. In the first test the subject suddenly reached out her hand in order to point out the location of the image, and was greatly surprised when her hand came in contact with a

real object in that position. Only those images foveally perceived were affected in this manner, and their size was always increased in proportion to the nearness of their location. This fact is directly contrary to the usual results as to the size of after-images when projected on backgrounds of different distances from the observer. However, in the above case it must be borne in mind that the eyes remained adapted for the distant position, instead of becoming converged upon the invisible screen.

The retinal effectiveness of these new stimulations is genuine. The pupillary reflex is indubitable proof. The screen though not perceived influences the distance of the displaced images. The diffused yellow glare is undoubtedly due to the stimulation of the lights. The subject was ignorant of the tests in the majority of the cases so that the results probably cannot be due to conscious suggestion. The absence of retinal effectiveness might be shammed by the subject, but there could be no deception when retinal effects are present, unless she had knowledge of the nature of the experiments to be performed.

D. *The objects primarily fixated, though not perceived at their real positions, effectively influence in various ways their displaced images so long as their stimulations can reach the retina.*

This influence may be tested by displacing the field more than ninety degrees, by covering one of the objects with a screen, by moving an object in the field, or by removing an object entirely from the range of possible vision.

1. A removal of an object from the range of vision was finally effective in all of the experiments. A few cases will illustrate the general nature of the results. The electric lights were fixated and displaced about twenty degrees. Shortly afterwards they were turned off. The displaced image of the light immediately exhibited a marked decrease in brightness but remained visible during the continuance of the test. The writer stood in front of the window and was fixated by the subject. After the displacement, he suddenly dropped down out of the range of vision. After a half minute his displaced image disappeared entirely from sight, though the images of the other

objects in the field remained in distinct view. The place of image was not filled in by the surrounding visual content, *i. e.*, the bright light of the window. Neither was the window back of his body now perceived. The space was filled in by a homogeneous light gray content, a light shadow silhouette effect. Upon rising up again to the original position, a rather hazy image appeared to view but still in its displaced position. The subject was ignorant of the nature of the test. A book was held before the window and fixated. After the displacement it was removed, and in a short time its image disappeared. The book was now brought back into the field of vision, but it was placed a foot below its original position. Its displaced image reappeared, but at a position a foot below that from which it had disappeared. The test was repeated a number of times, the object being introduced into the field at various positions relative to its original location. The same results obtained; the reappearing image was always displaced from the true position of the object and bore the same spatial relation to its position of disappearance as the new location of the real object did to its primary position. The object was never perceived simultaneously in the two positions. The first image always disappeared before the second image was seen in the new position. The reappearing images were much dimmer than their originals and were always perceived with some difficulty. The objects were easier to perceive when brought back to their original position than in the case where they were introduced in a new position.

Since the existence of the image of the removed object depends upon the presence or absence of that object in the field, although the other images in the displaced field remain visible, it follows that the objective stimulations must be effective in maintaining the vision of their translocated images. Ignorance of the tests disposes of the possibility of any sham or suggestion.

The removal of an intensive stimulation from the original field thus produces a decrease of brightness in its displaced image. If the stimulation is weak, its displaced image finally disappears. If the object is returned to the field, perception occurs with difficulty and the new image is much dimmer than

the original one. The new image occupies the same relative position in the displaced field as the new location of the object does in the primary field.

2. Movement of an object in the primary field may produce a change of location on the part of its image. If the movement is slow, a perception of motion may result.

At night the writer stood in the field of view. During the displacement, the arm was lifted up slowly to a horizontal position. No movement was perceived at first. After the arm had moved about half the distance, the subject noted its new position and then perceived it in motion for the remainder of the distance. The perception was very vague and difficult. The arm seemed to be a mere transparent shadow, for the subject could look through it and see the visual objects past which it moved. The experiment was repeated while standing before a bright window. No movement was perceived; the arm was finally seen in its extended position, presenting a very shadowy and unsubstantial appearance, markedly different from the remaining part of the body. The electric lights were fixated and displaced ten degrees against a dull yellow wall. The light was then set swinging, pendular fashion, quite rapidly. The arc of movement was two feet in extent. The displaced image of the light was described as quivering in a vibratory fashion as though it were rigid and had been violently jarred. In a similar test, the light was slowly moved backwards and forwards through an arc of three feet. A similar motion on the part of its displaced image was perceived, but its extent was judged to be only six inches in length. This decrease in length was not due to the subject's ignorance of linear values, for the extent of movement was represented graphically after the test. Whether the perceived motion was synchronous with the motion of the light, or lagged behind it an appreciable time, I do not know, though the latter condition probably obtained. The image of the moving object was never seen in two positions simultaneously; the image in the first position disappeared before the moving object was perceived in its second position.

These results are genuine, for I attempted to induce such movements by suggestion, often asserting that my arm was

being elevated and requesting the subject to perceive the movement if possible. Such attempts were invariably unsuccessful. When the field was displaced more than ninety degrees, the movement of an object produced no effect upon its image. In this case, the object no longer stimulated the retinæ. Objects were also moved after being hidden behind a screen; this movement effected no results upon the displaced image. Consequently suggestion cannot explain the results.

3. The various results obtained by the interception of the original stimulus by the introduction of a screen are partly due to the new stimulation introduced as well as to the removal of the old one. The results due to the new object have been enumerated and described in a previous section (C, pp. 362 ff.). Certain other phenomena occur, however, which are due to the removal of the original stimulus from the retinæ. In the tests at night a screen was interposed just in front of the candle originally fixated. The image of the candle did not disappear, but flared out to a large size with an indeterminate contour and a marked decrease in luminosity. The image resumed its normal appearance when the screen was removed. The test was repeated several times in immediate succession with the same results. The screen was placed immediately in front of both eyes. All visual objects in the displaced field disappeared almost at once, but the subject continued to see the space between the screen and the distant wall as though nothing had happened; this space appeared light and transparent as in normal vision. The background, *i. e.*, the image of the wall, merely faded away into nothingness; the further limit of the perceived empty space was thus not blackness but a mere void. After a short time the image of the candle reappeared at the distance of the screen, though all other objects in the field remained invisible. When this image of the candle reappeared to view, vision of the empty space beyond the screen was lost. With strong illumination (fixating the window on a bright day), a screen interposed just in front of the object of fixation produced no noticeable results on the character or continuance of its image. When the screen was placed immediately before both eyes so as to intercept the entire field, certain objects in

the far distance which were perceived through the window disappeared from vision at once, but the images of the window and surrounding walls as well as of the intervening space remained visible for nearly a minute. After this period the small part of the window foveally perceived became located at the distance of the screen. The subject's attention was now attracted to this, and she did not notice whether the remaining part of the field continued to be visible at its distant position. However, the empty space beyond the screen was still perceived until the end of the experiment.

The apparent results of these tests may be stated as follows: When the original stimulation is intense and a small portion of the field is intercepted, no effect upon the duration of the displaced image is noticeable. When the stimulation is weak and the whole field is intercepted, the displaced images disappear almost immediately. Intermediary results can be obtained with mean conditions.

4. The influence of the original stimulations may be inferred from certain results obtained by a displacement of more than ninety degrees. The introduction of the electric lights before the eyes produced more marked results in case the field was displaced to such an extent that the original objects perceived no longer stimulated the retinæ. Moreover, the results occurred more quickly with such extreme rotations than they did with a small displacement. The object introduced into the field was perceived as an object only in the case of such an extreme rotation.

The displaced images thus possess a greater resistance to the influence of new stimuli so long as the primary field continues to stimulate the retinæ.

E. *The effect of an old stimulation is much greater than, and far different from, that of any new stimulus introduced during the displacement.*

1. An old object introduced into any part of the field after its removal is perceived as an object under conditions where the introduction of a new object would produce no visual effect whatsoever.

This general statement is derived from a comparison of the

results of the tests described in sections B, C, and D. The following test was performed to illustrate the proposition. Under conditions of weak illumination, I stood in the field of view holding an unlighted candle in my hand. The hand was fixated and a ten degree displacement of the field was secured. I now moved out of the range of possible vision and lighted the candle. After my displaced image had disappeared from view, I came back to the original position. The image of myself and candle now reappeared, but the light was not perceived save for the dim and vague luminosity suffusing the field. It would be possible to choose conditions under which even this dim luminosity would not occur.

2. The effect of a new object tends to be diffused over the visual field, while the effect of an old object tends to be definite and localized.

The first case is illustrated by the diffused luminosity of the candle and electric lights. The second statement is illustrated by a number of facts. The displaced image of the electric lights decreased in intensity the moment the light was turned off, although no effect was noted on the remaining part of the field. The removal or movement of an object in the primary field produced visual effects which were confined entirely to the displaced image of that object. When an old object was brought back into any part of the field, it was perceived as an object, *i. e.*, its visual effects were definitely localized in space.

3. The visual effects of a new object are projected in accordance with the normal laws of retinal space reference. The image of an old object re-introduced into any part of the field is perceived in a displaced position.

As illustrations of the first statement we may cite the following tests: In the case where the candle introduced into the field after a displacement was perceived as a candle, it was correctly localized. It was placed directly in front of the subject's eyes and it was perceived in that position. In the case where the eyes were directed at the electric lights for three minutes during a displacement, the diffused luminosity became concentrated in a large circle in the center of the field of vision. If this ring of light represents the stimulation of the lights, as has been

assumed, it was correctly localized. The second of the above statements represents the results given in section D, (1) and (2).

F. *This peculiar and abnormal functional condition of the eyes obtaining during the displacements may be maintained, destroyed and reinstated at will. The condition is maintained or reinstated by a mental fiat accompanied by an orbital strain, while the condition is discontinued at any time by a mental fiat and a relaxation of the orbital strain.*

1. Maintenance of the displacement. During the various tests, a careful observation was made of the subject's motor attitudes and expression in initiating and maintaining the displacements. The body generally remained quiet but exhibited a suppressed tenseness as though the whole energy of the body was being concentrated upon the task in hand. The breathing was slow, quiet and regular, but much deeper than usual. The subject appeared slightly enrapt or entranced as one does with extreme absorption in some observation involving steady fixation. The extreme concentration was due to the facts that the tests were generally of some duration, the subject's attention was directed to the observation of all changes occurring in the visual field, while many of the phenomena were novel in character. It was found on trial that the field could be displaced and maintained in a given position with a relaxed condition of the body and with normal breathing. No expression was noted other than that occurring in a case of ordinary fixation. Introspectively, the only necessary conditions for the maintenance of the displacement were a marked strain located in the head directly back of the eyeballs, and the focusing of the attention upon the images.

2. The discontinuance of the state. We found that it was not necessary to move the field back to its original position in order to discontinue the state. The subject generally shook her head, moved her eyes, blinked several times and relaxed her bodily tension. The subject was asked to give an account of her method of discontinuing the state at will, but was unable to do so with the exception that she had noted that it was not necessary to move the field back to its primary position. This method was made an object of study in a number of experi-

ments. It was found that a sudden head or eye movement generally caused the field to disappear momentarily during the movement. The movements, blinkings and the bodily relaxation were not necessary to discontinue the phenomenon though they were of some service. The only necessary concomitants of the mental decision were the release of the attention from the images, and a relaxation of the orbital strain mentioned above. The displaced field does not disappear immediately, but fades away gradually. The time necessary for the disappearance of the images seemed to vary slightly in the different tests. Probably, the time is proportional to the intensity of the original stimulations. The average duration necessary was from three to five seconds. The recovery of normal vision does not occur immediately after the disappearance of the displaced images. There is an intermediary period in which the visual field presents a uniform gray hazy appearance. The images of the real objects now before the eyes break through this hazy mist and gradually become distinct. The whole process involving the disappearance of the displaced field and the recovery of normal vision lasts from four to seven seconds.

3. The reinstatement of the displaced field after its disappearance. After normal vision has been recovered, the displaced field may be brought back to consciousness at will without the necessity of again subjecting the eyes to the original stimulations. A mental decision involving a thought of the objects and the reinstatement of the orbicular strain is the only condition necessary to effect this result. Merely thinking of the objects is not sufficient to produce the reinstatement. The displaced field does not come back gradually but *instantaneously*. The subject had not been aware of her ability to recall these positive after-images at will and first attempted it at my suggestion. The results were so immediate and pronounced as to startle her. The phenomenon is best described in the subject's own words: "No sooner had I willed than the displaced images burst upon me in full bloom as though they had been hidden behind a screen and this screen had been suddenly jerked away." With the return of the displaced images, the eyes were subjected to the various tests described above in order to deter-

mine their sensitivity. The eyes are now in exactly the same condition of sensitivity as they were during the original displacement. This voluntary alternation of the abnormal condition of the eyes and of normal vision may be successively produced in the same experiment apparently as many times as desired. In one experiment the field was displaced more than ninety degrees and projected against a background of new objects. The subject was directed to hold the eyes as motionless as possible, to allow the displaced field to disappear until distinct vision of the new background was secured, to call back the displaced field so as to hide all vision of the new background of objects and to alternate the two states as long as possible. The two conditions were alternated six times in succession, when the subject was compelled to stop through fatigue. Apparently, fatigue is the only limitation on the possible duration of the phenomenon. In every case normal vision was effected gradually while the abnormal condition was reinstated immediately.

G. *The visual field may be moved at will in a third dimensional direction. The backward movement is effected by an 'effortful feeling of expansion' within the eyeball, while a 'feeling of contraction and relaxation' in the same locality accompanies a forward direction of movement. During these movements the same abnormal condition of sensitivity obtains as in the case of the lateral displacements*[1] *already described.*

At the time when the lateral displacements were first noted (seven years ago), third dimensional movements of the field sometimes occurred involuntarily, especially under conditions of fatigue or of prolonged fixation. By trial, it was found that these movements were also subject to voluntary control. They can be produced voluntarily much more easily and after a shorter period of fixation than can the lateral displacements.

The field cannot be moved forward to a distance nearer than five feet from the subject, but it can be removed to the apparent distance of the horizon. Within these limits, the field can be

[1] The translocatory movements already described in the previous sections will be termed hereafter 'lateral displacements,' in order to distinguish them from these third dimensional movements.

moved and located at will. The images do not become double, but are blurred to some extent and are rather confused in outline. With the backward direction of movement, the images become slightly smaller, but the decrease in size does not seem to be proportionate to the increase of distance according to the laws of perspective. The decrease in size seems to be due to a 'melting away of the edges' of the various images. In the return movement, the field is judged to have reached its real position when the images attain to their maximum distinctness of outline.

The movement can be effected with monocular vision, but it occurs much more readily with the left eye than with the right. On the return movement with the right eye, the field does not move forward gradually but jumps back quickly in an involuntary manner. The images grow less distinct and a trifle smaller with the backward movements. The decrease in size seems to be due to a 'fading away of the edges.'

When the field is moved backward toward the horizon, the subject experiences a 'feeling of expansion' which is located inside of the eyeballs directly back of the cornea. The forward movements are accompanied by a 'feeling of contraction' in the same locality. The feeling of expansion is described as effortful, while the contractile feeling is accompanied by a sense of relaxation.

At first it was supposed that these depth movements were entirely distinct in nature from the displacement phenomenon, and that they were another instance of that voluntary control of the depth location of the visual field possessed by Miss Allen.[1] This inference was not wholly correct. During a depth displacement, the visual field may be displaced laterally, or it may be moved in a third dimensional direction during a lateral translocation. During the prolonged tests on the lateral displacements, the subject often lost control of the distance location of the displaced field and it would suddenly recede from five to ten feet. A series of experiments was performed in order to test the sensitivity of the eye during the depth movements. If anything, the eye is more insensitive during this phenomenon

[1] PSYCHOLOGICAL REVIEW, Vol. XIII., No. 4, pp. 258–275.

than it is with the lateral displacements. Various objects were introduced into the range of possible vision, but they were not perceived, nor did they affect the visual field in any way. A lighted candle held at a distance of three feet directly in front of the eyes did not even suffuse the distant field with a luminous glow. When objects were removed from the field, the period necessary for the disappearance of their images was longer than in the case of the previous phenomenon. The movement of an object in the field was not perceived, though the object was finally seen in its new position. Objects re-introduced into the field were perceived with extreme difficulty unless they were brought back to their original positions. In the latter case the image of the object is more intense and realistic, and it appears to view in less time after the introduction of the stimulus.

The fact, however, that the moving visual field is of the nature of a hallucinatory positive after-image, does not explain the mechanism of its distance location. The lateral displacements are due to head or eye movements, and the depth changes must likewise be attributed to some factors just as in the case of the distance location of any after-image, either positive or negative. Moreover, the changes must be due to factors over which the subject has direct voluntary control. While this phenomenon is essentially different from that exhibited by Miss Allen so far as the retinal sensitivity is concerned, yet it is possible that the two cases are similar in respect to the mechanism involved in this voluntary control over the depth location of the visual imagery. In the case of Miss Allen, the depth movements were conditioned by lenticular adjustments which involved no convergent changes of the eyes. With the present subject, no convergent movements occurred. This fact supports the proposition previously enunciated as to the retinal effectiveness of the stimulations from a primary field, for if the eyes were totally free from the influence of the objects primarily fixated, it is inconceivable that the convergence should remain unaltered while the visual images are subject to such marked changes in respect to depth location. As to the presence of lenticular adjustments, no confident assertions can be made. I was under the impression that lens changes occurred, but the

movements were so slight in extent that I could feel no absolute confidence in the validity of the observations. The movements were so small that it was impossible to detect whether a particular kind of adjustment was invariably correlated with each direction of image movement. The small extent of the movements present, in case the observed results are valid, is explicable from the fact that the possible extent of the third dimensional movements of the visual field was greatly diminished in the dim illumination necessary to a phakoscopic examination. The lack of clear-cut definite results, as in the case of Miss Allen, does not disprove the lenticular theory; neither do the observations furnish indubitable proof that the depth displacements are conditioned by appropriate adjustments of the lenses, though they do support that theory to some extent. During the displacements pupillary changes occur, but they are spasmodic and irregular in character, no definite change being invariably correlated with each direction of image movement. The fact that the displaced images become blurred and confused in outline in the third dimensional movements, but do not do so during the lateral displacements, indicates the presence of lenticular disturbances in the former case. The presence of muscular feelings inside the eyeballs in the region of the lens may likewise be interpreted in favor of the theory. On the whole the writer is disposed to believe that lenticular changes do occur and condition the movements to some extent, though they may not constitute the sole explanation of the phenomenon. The possibility of other conditioning factors is a matter of speculation and any such discussion is beyond the range of this paper.

The preceding account has purported to be as much as possible a factual statement of the various experimental results with little comment or theoretical digression. Some peculiar aspects of the case deserve further consideration.

Such visual anæsthesias, wherein objective stimulations are retinally effective and may indirectly influence consciousness, occur with hysteria and may be induced by suggestion. So far as the writer is aware, however, such anæsthetic retinal areas do not subserve any objectified visual consciousness, as

with the present subject, unless hallucinatory images are induced by suggestion. The hallucination and the insensitivity seem to be a single phenomenon rather than two independent events, for they invariably occur together. This is seen from the fact that there is no stage of a total lack of visual sense content intervening between normal vision and the abnormal condition. When the displaced field is caused to disappear, there is, it is true, an intermediary stage wherein the visual field presents a uniform undifferentiated appearance. But this is not a total blindness, for an objectified visual sense content is present. When objects were removed from the field and their displaced images were allowed to fade from view, no gap was left devoid of all sense content. This close relation between the presence of the hallucinatory field and the insensitivity, and their relation to volition are matters for discussion. Three theories may be conceived as to the relations involved:

1. The anæsthesia may be assumed to be directly subject to volitional control, while the hallucination is an effect of the anæsthesia. The first relation is conceivable for such anæsthesias can be induced by suggestion, but the second causal nexus is hard to conceive and some facts contradict the assumption of any such invariable connection. An involuntary semitrance, involving a visual anæsthesia and a complete aboulia has frequently occurred throughout the subject's life. This visual anæsthesia generally involved a complete loss of all sense content, *i. e.*, it did not produce an hallucination.

2. It may be supposed that the two phenomena are independent events and are controlled by separate volitional processes, but, since the two results cannot be separately initiated, it must be assumed that each event is due to a particular process within the whole volitional act, but that the two processes are so associated that they cannot be even consciously separated. This theory may be true for all that is known to the contrary, but it is needlessly complex.

3. We may assume that the hallucination is volitionally controlled, but that the presence of the hallucinatory images is the cause of the anæsthesia. The second relation may be illustrated by the following phenomenon: Let the light from a bright

window be reflected into the left eye by one's glasses. The image of the window is now projected against the wall of the room. If the right eye is closed, the wall back of the projected image remains invisible in spite of all efforts to perceive it. The stimulations from the wall enter the eye and reach the retina, but vision is so dominated by the image of the bright window that the stimulations from the wall fail to influence it effectively. Likewise, it may be conceived that the hallucinatory activities so dominate the visual centers that these latter are impervious to the objective stimulations. The phenomenon is thus a matter of visual rivalry. This conception is supported by the general result enunciated in section C that the visual effect of any new stimulation introduced varies with its intensity, extent, and duration, and also according to the brightness of the primary field, *i. e.*, the intensity of the hallucinatory field. In the volition her attention is positively directed toward the visual images in the reinstatement and maintenance of the hallucination, and it neglects them in order to discontinue the state. This fact supports the view that volition deals directly with the hallucination and that the insensitivity is a secondary by-product. The supposition may be further supported by the fact that the stimulation of an old object is more effective when it is brought back to its original location than when it is introduced into the field in some new position. In the former case the image is more vivid and realistic and is perceived in a shorter time after the object is returned to the field. This result may be conceived as due to the fact that the stimulation in any secondary position comes into rivalry with a hallucinatory image of some other object.

There is a real spatial translocation of the effects of retinal stimulation in certain cases. This is illustrated in Fig. 1. Suppose that the eye momentarily fixates the object *F*, while *C* is perceived in indirect vision. The points *f* and *c* are the retinal areas stimulated by these objects. The eye is now rotated upward until the optic axis is directed toward *F'*. The stimulations from the objects *F* and *C* now meet the retina at the points *b* and *a* respectively, while the images of those objects are perceived in the positions *F'* and *C'*. These periph-

eral stimulations at *a* and *b* influence the brightness, duration, location and existence of the visual images *F'* and *C'* which should normally correspond to the retinal activity of the areas *f* and *c* respectively. It is as if the effects of the stimulations of *a* and *b* were transferred to the points *c* and *f* respectively. What is true of these two stimulated areas is also true for all retinal points. Thus every retinal area, *c* for example, transfers the effects of its own stimulation to another area *d*, and in

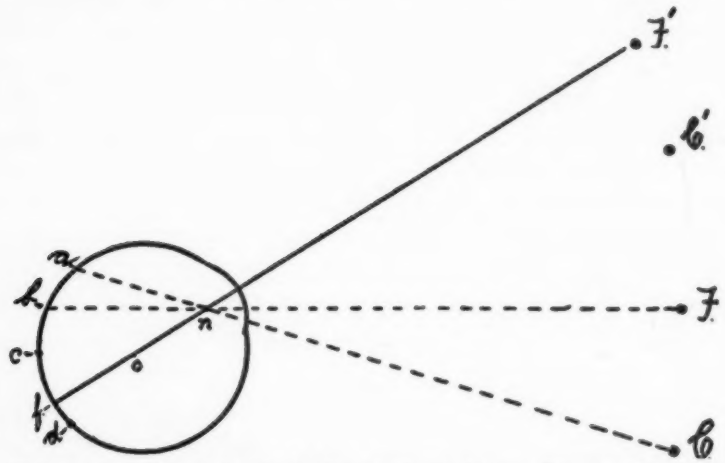

FIG. 1. *F* and *C*, objects in the field of vision; *F'* and *C'*, displaced images of the objects *F* and *C* after the eye rotation; *n*, nodal point; *o*, center of rotation; *f*, fovea; *f-o-n-F'*, optic axis after the rotation; *a*, *b*, *c*, *d*, retinal points.

return it receives the effects of the stimulation of the area *a*. However this apparent 'transference' of the stimulation of one area to a second retinal area occurs only for 'primary stimulations,' *i. e.*, only for those objects occupying the original field of vision. In the case of 'secondary stimulations' — those resulting from new objects introduced into the field of vision after the displacement — there is at first an apparent retinal 'diffusion'; the results of the stimulation are diffused so as to tinge appropriately the entire visual field. This diffusion is minimized in extent in proportion to the duration and intensity of the secondary stimulation.

As to the nature and mechanism of this 'transference' and

'diffusion' several possibilities are open. It may be supposed that the retinal space reference has been altered. Ordinarily the image corresponding to the stimulation of a point *b* on the retina is localized along a line running through this point and the nodal point *n*, but this spatial reference of the retina may be altered in certain conditions, *e. g.*, the partial paralysis of an eye muscle. This conception is disproved by the fact that the retina localizes normally in the case of a prolonged and intensive secondary stimulation, although the transference of the primary stimulations still obtains. While the conception might explain the 'transference phenomenon,' yet it is inadequate to account for the 'diffusion of secondary stimulations.'

The phenomena may be supposed to be either retinal or central affairs. In fact, they have been couched above in retinal terms, but this was done merely for descriptive and not explanatory purposes. Analogous results have been obtained in experimental psychology. The irradiation phenomenon, simultaneous contrast, etc., indicate that in normal experiences the conscious effects of any retinal stimulation are not confined wholly to the corresponding part of the visual field, but it is not known whether this diffusion of results is centrally or retinally conditioned. The question is further involved with the general problem of the seat of hallucinatory activities, as to which there is no unanimity of opinion. Consequently, there is no positive evidence to be derived from other sources in favor of either conception. So far as anatomical possibilities are concerned a central location is preferable. The fact of voluntary control over the existence and duration of the transference is more explicable in central terms. A statement of the facts, however, in either retinal or central terms would do little but localize the phenomenon. The mechanism and *raison d'être* of the process would still remain unintelligible.

The conception which seems most satisfactory to the writer involves several propositions: (1) For all points *a*, *b*, *c* on the retina there are corresponding cortical areas *A*, *B*, *C*. The habitual pathway of a retinal impulse from any point is to its corresponding cortical area (Fig. 2). The course of any impulse may be varied under certain conditions. It is not neces-

sary to assume that the spatial arrangement of the cortical areas is in any way similar to that of their corresponding retinal points although they have been represented in that manner in the figure (2). The hallucinatory images of the displaced field are due

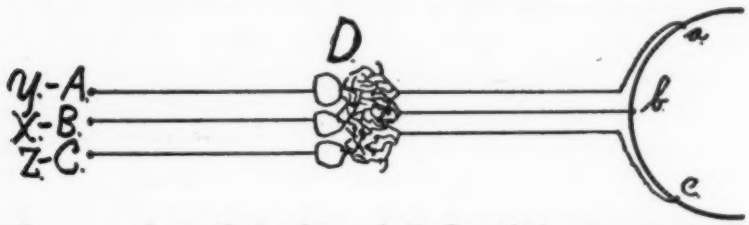

FIG. 2. *a*, *b*, *c*, retinal points; *A*, *B*, *C*, cortical areas corresponding respectively to *a*, *b*, *c*: *Y*, *X*, *Z*, displaced images due to activity of *A*, *B*, *C*, respectively; *D*, subcortical center.

mainly to cortical activities, and (3) these cortical activities are so intensive and dominating that they interfere with the habitual behavior of the incoming retinal impulses. These impulses become blocked at the subcortical center *D*.

We will suppose that the eye perceives three objects, *X*, *Y* and *Z*, corresponding to the three neural processes represented in the figure. The images of these objects are now displaced by an eye movement, and a new object, *V*, is introduced into the field so as to stimulate the retina at *b*. This retinal impulse is checked at *D*, and hence a diffusion of the impulse occurs. If the stimulation is weak, the effects are drafted off to lower centers without conscious effect. A greater intensity of stimulation gives a diffused effect over the entire visual areas. In case the stimulation is very intense and prolonged, the retinal impulse becomes strong enough to supplant some one of the cortical activities. The impulse will traverse the line of least resistance, and this will be along the habitual pathway *b*-*D*-*B*. The object *V* will thus be localized in a normal manner. The displacement of the images *Y* and *Z* and the correct localization of the new object *V* are thus possible.

As a result of the eye movement, the object *Y* now stimulates the retina at *c* instead of at *a*. This retinal impulse becomes blocked at *D* because of the cortical activity of *C* involved in the displaced image *Z*. This impulse will finally

break through the hallucinatory field at the point of least resistance. With primary stimulations this point of least resistance is not along the habitual pathway *D-C*, but it is at the cortical area *A* involved in the displaced image *Y*. This area *A*, being strongly excited centrally, forms an apperceptive center highly susceptible to an appropriate stimulation. The impulse from *c* is transferred to *A* by the subcortical center *D*. This theory assumes that a psycho-cortical activity will block an habitual path to impulses which would arouse qualitative dissimilar responses in that center, while it will markedly increase the susceptibility of that area to appropriate impulses. This conception involves no new doctrine, for the same principle is used to explain the selective character of apperceptive attention; central activities increase the mind's sensitivity to stimulations of an appropriate character but decrease its susceptibility to all other stimulations. Thus it is not necessary to posit the existence of a subconscious mind in order to explain the subject's ability to react differently to the two kinds of stimulations.

The volitional control over the existence and duration of the hallucinatory images is a noteworthy fact, for generally such experiences possess all of the involuntary characteristics of percepts. What causal relation the orbital strain bears to the existence of the abnormal state is a subject concerning which it is idle to speculate. It is also rather curious that this abnormal condition does not seem to be subject to suggestion in any way, although it is so susceptible to volitional influences.

The subject of these experiences was under the writer's observation for six months and the experimental work covered a period of three months. Owing to the subject's susceptibility to fatigue, it was impossible in this time to investigate the phenomenon as thoroughly as desired. The case deserves further study, as many interesting problems came up during the experiments whose solution would certainly give a more comprehensive insight into the phenomenon.

The subject comes of a well-to-do and cultured family. She is an only child and was reared in comparative isolation from those of her own age. She has been much addicted to day dreaming and she possesses an artistic, idealistic and sensitive

temperament. Her physical health has always been good. She is physically well-developed, and her appearance gives every indication of healthful bodily functioning. She has been subject all her life to short attacks involving visual anæsthesia and aboulia. These attacks are congenital on the mother's side of the family. She has often experienced other seizures involving faintness and extreme physical weakness, with the presence of only a dim vague consciousness. These attacks often leave the subject in a very weak condition for some hours. Shortly before the phenomenon described in this paper was first noticed, she experienced a more profound attack resulting in some permanent amnesias. The complete loss of auditory musical memory incapacitated her for her vocation as a music teacher. Her retentiveness for academic subjects was much impaired. She is now extremely susceptible to fatigue. Her case was diagnosed by a competent nervous specialist who found that she was unable to converge upon objects at a distance of less than eight feet. She has been using a set of prisms to strengthen the internal recti muscles and finds that their constant use has had a beneficial effect upon her mental ability.[1]

[1] The MS. of this article was received October 15, 1907.

CONCERNING ANIMAL PERCEPTION.

BY PROFESSOR GEORGE H. MEAD,

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I wish to call attention to a phase of animal psychology which has received, it seems to me, but inadequate treatment. This inadequacy is evident not only in the general psychologies, but also in special experimental investigations of animal intelligence. The difficulty gathers about the doctrine of perception, and is due in part to the incomplete character of the theory of perception in human psychology, and in part to a failure to analyze sufficiently the conditions of possible perception in lower animal forms.

Can we draw a line between perception and higher cognitive processes, leaving below the line a cognition which is not rational though intelligent, such as characterizes the adaptations of a crab or a rat, and placing above the line all the consciousness of relation which makes human intelligence rational? Do our own predominately perceptive processes, such as those of rapidly climbing a steep, rocky cliff, or playing a game of tennis, where we are seemingly unconscious of anything except the physical environment and our reactions thereto, differ qualitatively from the more abstract processes in which we consciously deal in symbols and isolate the relations of things?

If these discursive processes are mere developments of contents which are implicitly present in perceptual consciousness, is there any definite line which can be drawn between the intelligence of man and that of the lower forms, unless we deny them the form of consciousness which we call perceptual in ourselves? Hobhouse,[1] for example, assumes that the cat, the dog and the monkey, which he observed, apprehend perceptual relations, which enabled them to learn by experience, without the ability to isolate the relations as elements in thought.

Stout[2] would grant to the chick that learns to reject a cin-

[1] *Mind in Evolution*, p. 117.

[2] *Manual of Psychology*, pp. 84 ff.

nabar caterpillar, an 'apprehension of meaning or significance, which would come to the same thing. On the other hand, Thorndyke[1] explains such learning by experience on the part of lower animals through the association of an 'impulse' with a stimulus, which seems to imply a qualitatively different state of consciousness from that which would ordinarily be called perceptual in human experience. He undertakes to illustrate this by phases of human consciousness in which even perception would be reduced to a minimum. This latter illustration indicates a possibility of discrimination which seems to me to have been but inadequately recognized. In learning to play billiards or tennis, we are moving in a perceptual world, but the process of improvement takes place largely below even the perceptual level. We make certain movements which are more successful than others, and these persist. We are largely conscious only of the selection which has already begun. We emphasize this and control to some extent the conditions under which the selection takes place, but the actual assumption of the better attitude, the actual selection of the stroke, lies below even this level of consciousness. Thorndyke calls this selection a process of stamping in by the pleasure coming with success. This explanation, however, calls for its own explanation and ascribes active control to states of pleasure and pain, which is by no means proved and opens up another field of dubious animal psychology. Thorndyke calls the process of improvement an association of an impulse and a stimulus, which lies quite outside of associations of ideas. The phrase is perhaps a vague one, that calls for further specification, but it answers to a large number of instances which are commonly conceived of as perceptions by the animal psychologists, although it is to be presumed that Thorndyke himself assumes that these animals move in a perceptual world. The instances to which I refer may be well illustrated by the action of the chick in rejecting the cinnabar caterpillar or the orange-peel. Is there a revival of the past experiences which leads the chick to reject these disagreeable objects; or may we assume that the impulse to reject has become associated with this particular stimulus, without any intervening redintegrated psychoses?

[1] 'Animal Intelligence,' PSY. REV. MON. SUPPL., Vol. II., No. 4, pp. 65 ff.

This question is closely allied to that which arises with reference to the plasticity of the young form and the manner in which it acquires the specific habits which are not found performed in its nervous system. A chick learns to make use of the impulse to hide when a hawk sails overhead. A young fox learns to run away from the odor of man. The process of hiding and running away are indeed performed in these young animals. It is the association of the instinctive action with determinate stimuli which is acquired. What seems to take place is this: The animal tastes a disagreeable morsel when it instinctively strikes at a moving object before it. The action of the flavor of the morsel upon the organs of taste sets free an equally instinctive reaction of rejecting the morsel. At the same time, the chick eyes the caterpillar under the excitement of the disagreeable experience. Now the caterpillar hereafter to be avoided must be different from a mere moving object such as would have called forth the reaction of pecking. It is fair to assume that the condition for this discrimination made by the chick lies in the different reaction which it has called forth. The mere redintegration of the experience would not protect the chick. Either the chick would peck again, since presumably the same bad taste and same rejection would follow, simply reinforced by the revival of the past experience, and this would bring about no improvement in adaptation; or else the past experience would be revived with the appearance of the old stimulus. This stimulus was not a caterpillar with certain markings, but a moving object within reach. The revival of the experience with this generalized stimulus to which, as Lloyd Morgan's experiments show, the chick reacts, would lead to the rejection, not of cinnabar caterpillars alone, but of all moving objects within reach. The ability to distinguish between stimuli which had been identical in their value before, arises together with the new reaction, that of rejection. The meaning of the plasticity of the young form seems to be that there exist in the form instinctive reactions which have not as yet determined external stimuli. Through the experience of the animal the appropriate stimuli are determined. One condition, at any rate, is found in the new visual or olfactory expe-

rience which arises when, for any reason, this new reaction takes place. A dog's shrinking from the sight of the whip involves not simply the revival of the painful experience of the flogging; it involves his reacting to characteristicts in the sight of the whip which led to no reaction at first. It is not then so much the association of an old visual or olfactory experience with the impulse, as the arising of a new visual or olfactory experience which now becomes the stimulus for the particular impulse or reaction. If there be association of ideal contents, it is between this new visual or olfactory experience and the old experience which had not as yet been discriminated; of this association, Mr. Thorndyke remarks,[1] we have little or no evidence. What we must assume, in what is implied above, is that the animal gets the new visual or olfactory experience because it is carrying out a new reaction; that the ground for discrimination in sensation lies in the difference of reaction to that which is sensed, an assumption that is reinforced by the recognition that the process of sensing is controlled and directed by the reaction to the stimulus.

Now what is implied in perception is the association of the new sensory experience with the old. If the chick perceives a caterpillar as a 'thing,' he may associate the former experience of pecking at a thing with the new experience of rejecting the peculiarly marked thing. But evidence for such an association in the case of the chick certainly is lacking. What has appeared in its conduct is a new stimulus of a visual character for a performed reaction, which up to this and other like experiences had no determined visual stimulus.

The question then arises, what are the conditions for the appearance of this permanent core to which varying sensory elements may be associated? It is impossible to appeal directly to the introspective analysis of human perception. We cannot get inside the consciousness of the lower forms. It is, however, possible to find in our own experience of physical objects what constitutes this core which endows it with its Thinghood, and investigate the conduct and sensory equipment of these forms, with a view to determining whether their experience can also contain this identical core to which varying phases of the same

[1] *Loc. cit.*

object can be referred. Stout[1] finds this core in what he terms 'manipulation,' understanding by this any contact experiences which arise as the result of visual stimuli, such as the hearing, scratching, pulling, shoving, as well as our actual handling of what we see. This he illustrates by the visual experience of a hole to which an animal is fleeing and which answers to an experience of contact, that enables the animal to determine whether the opening is passable.

If this distinction be carried out somewhat further, we find that the sensory experiences of animal life may be divided into two categories: those that come through what may be called the distance sense organs, the visual, olfactory and auditory senses, and those that come through the contact sensations. The distinction suggested by Stout's use of the term 'manipulation' is that intelligent conduct, when it reaches the stage of perception, implies a reference of what comes through the distance sensations to contact sensation. There is perhaps nothing inherent in contact experiences which accounts for their being the substantial element in perception — that to which, so far as physical, *i. e.*, perceptual, experience goes, all other experience is referred. Visual discriminations are much finer and more accurate than those of manipulation. The auditory and olfactory experience are richer in emotional valuations. But it remains true that our perception of physical objects always refers color, sound, odor, to a possibly handled substrate, a fact which was of course long ago recognized in the distinction between the so-called primary and secondary senses.

The ground of this is readily found in the nature of animal conduct, which, in so far as it is overt can be resolved into movements, stimulated by the distance senses, ending up in the attainment or avoidance of certain contacts. Overt food, protective, reproductive, fighting processes, all are made up of such movements toward or away from possible contacts, and the success of the conduct depends upon the accuracy with which the distance stimulation leads up to appropriate contacts. Consciously intelligent conduct within the perceptual field lies in the estimate of the sort of contact to which distance sensory stimulates the animal form, that is the conscious reference of experience result-

[1] *Loc. cit.*, pp. 326 ff.

ing from the stimulation of the eye, the ear, the olfactory tracts, even the skin, by the movement of the air, etc., to the contacts which this stimulation tends to bring about.

The vast importance of the human hand for perception becomes evident when we recognize how it answers to the eye, especially among the distance senses. The development of space perception follow in normal individuals upon the interaction of the eye and the hand, and this interaction works a continual meeting of the discriminations of the eye by those of the skin, mediated through the manipulating hand. It is this contact experience which gives the identical core to which the contents coming from the distance senses are referred in the so-called process of complication. It is this core which answers to varying experiences while it remains the same. It is this core which is a conditio sine qua non of our perception of physical objects. Of course this content of contact experience is supplied by the process of association or complication out of past experience in most of our perceptions. The objects about us look hard or soft, large or small. But the reference is always there.

There are two respects in which the contact experiences of lower animal forms are inferior to those of man for the purposes of perception. The organs of manipulation are not as well adapted in form and function for manipulation itself, and, in the second place, the contact experiences of lower animals are, to a large extent, determined, not by the process of manipulation, but are so immediately a part of eating, fighting, repose, etc., that it is hard to believe that a consciousness of a 'thing' can be segregated from these instinctive activities.

To develop this second point a little further, we need only to recall what has been brought out by Dewey[1] and Stout[2] that perception involves a continued control of such an organ as that of vision by such an organ as that of the hand, and *vice versa*. We look because we handle, and we are able to handle because we look. Attention consists in this mutual relationship of control between the processes of stimulation and response, each directing the other. But while this control is essential to perception, perception itself is neither eating, fighting, nor any

[1] PSYCHOL. REVIEW, III., p. 359. [2] *Loc. cit.*

other of the organic activities which commence overtly with stimulation and end with the response. On the contrary, perception lies within these activities, and represents a part of the mechanism by which these activities are carried out in highly organized forms. Perception is a process of mediation within the act; and that form of mediation by which the possible contact value of the distance stimulation appears with that stimulation, in other words, a mediation by which we are conscious of physical things. The actual eating, fighting or resting, etc., are not mediations within the act, but the culminations of the acts themselves. We could not perceive bread as a physical thing if that cognitive state grew out of the presentation of the mastication and taste which constitute eating. We perceive *what* we masticate, *what* we taste, etc., except in so far as we may perceive, through their movements, our various organs, as things.

The great importance of the human hand for perception lies in the fact that it is essentially mediatory within the organic acts out of which the physiological process of life is made up. The presentation of a physical thing which must be made up out of the contacts necessary to the actual processes of eating or those of locomotion cannot offer as fruitful a field for the growth of perception as those which are based upon the mediations of the hand within the act. And the contents of contact experience which a mouth or the paws can present must be very inadequate, for just that function of correspondence between the elements of the retinal and the tactual experience out of which the physical world of normal perception arises.

To assume that a chick can find in the contact of its bill together with those of its feet the materials that answer to the perception of a physical thing is almost inconceivable. Even the cat and the dog must find in their paws or mouths, fashioned seemingly for the purposes, not of 'feeling things,' but of locomotion or tearing and masticating, but a minimum of that material which goes into the structure of our perceptions. In the case of the monkey the question arises whether the function of locomotion is so dominant in use of the so-called hands that that of 'feeling' can be isolated out of the monkey's contact experiences to build up perception.

Finally, to recur to the difficulties inherent in the doctrine of perception referred to at the opening of this paper, the assumption of a perception of things, that is, of what is mediatory in experience, carries with it the essence certainly of reasoning, *i. e.*, the conscious use of something — a certain type of experience — for something else, another type of experience. Every perceived thing is in so far as perceived a recognized means to possible ends, and there can be no hard and fast line drawn between such perceptual consciousness and the more abstracted processes of so-called reasoning. Any form that perceives is in so far carrying on a process of conscious mediation within its act and conscious mediation is ratiocination.[1]

[1] The MS. of this article was received September 18, 1907. — ED.

A STUDY IN VERTICAL SYMMETRY.

BY ELEANOR HARRIS ROWLAND.

It is obvious to anyone who looks at a series of pictures, landscapes especially, giving particular attention to the position of the horizon line, that he usually finds that line just above or just below the center, seldom at the extreme boundaries of the picture and almost never at the center itself. The question naturally arises, Is there any reason for this uniformity of choice and would the same conditions and demands hold good if reduced to the simplicity of an experiment? The following is an account of an inquiry into the choices made by eleven observers of divisions of a rectangular space, and an analysis of their methods of apperception.

To test the question the following apparatus was used: A black, rectangular picture-frame, with an opening 33 by 25 cm. had a black background placed behind, with light gray foregrounds of graded widths placed before it.

In the second series the background was gray and the foregrounds were black. These foregrounds were numbered from I. to XI. No. VI. measured 12½ cm. filling exactly half the opening while the others graded both ways at intervals of 2 cm.

The method of procedure was to start with the widest gray foreground and to exhibit all the sizes down to the narrowest, and back again, against the black background. Then the observer was asked to tell where she liked to have the dividing line come, and, if possible, to tell why she liked it that way. The same question was asked with the second series.

Out of eleven observers in Series I., four preferred to see the dividing line just below the center, or the No. V. card; two wanted the division just above the center, or the No. VII. card; two chose IV., while VIII., IX. and III. were each chosen by one person. In Series II. three observers chose No. V., two preferred IV., two VII. and two IX., while III. and XI. had each one vote.

The largest group, then, preferred a division just below the central line; another group preferred varying points slightly above the central line, while choices of the extreme divisions of II. and III. or X. and XI. were rare and those for equal division entirely absent.

The attention of the observers was called to this fact, and they were asked why they did not choose the central division. The almost uniform answer was, that when it was divided evenly they did not 'see it as a picture,' it was 'too flat and uninteresting.'

This testimony brought several things to light: (1) That with no comment on the part of the experimenter they had been taking the empty cards 'as pictures'; (2) that the very unequal division resisted their efforts to see it as a picture and therefore it was not chosen; (3) that with the equally divided space it apparently did not occur to them to 'see it as a picture' at all. Just as the slightly unequal spaces had naturally become landscapes, snow-scenes or sea-views, so did the equally divided space simply look like two equal cards. This change of apperception for the equal division was uniform, although none could give a reason why she had changed except that the equal cards 'didn't look like anything.'

The next questions put to them were:

1. Can you see the equally divided space, and the very unequal divisions as pictures and those formerly seen as pictures, as cards — that is, can the apperception be varied at will?

2. Is there any difference between the two modes of perceiving, except the presence or absence of associations?

3. Does your feeling-tone vary with this change of apperception?

4. Do you find it more difficult to vary your perception one way than the other?

5. Exactly what do you consciously do to change your apperception?

The answers to some of the questions were uniform, but the introspection varied in others. All of the obervsers found that they could vary their apperception at will, and that such variation not only supplied or deprived the cards of associative value,

but made them look *deep* or *flat*. When seen as a picture the background retreated, more or less according to the division (their favorite division usually had the greatest depth of any) but when seen simply as cards, the background moved front or the foreground back, to make a plane surface.

Their feeling-tone varied with this change of view, so that three liked the equal division, if they forgot it was equal and saw it as something else.

Most of them had more difficulty in changing the apperception for the very unequal divisions, but with practice they could also modify these at will.

The most interesting introspection came however on the last question, where despite their difference in expression, there was some agreement as to their difference in fixation point in the two cases.

When looking at the cards as at a *picture*, the attention was more centered, either on the dividing horizontal line or exactly above or below it, but always on the median axis. They looked from this point to other parts of the surface, but always turned back to the same central point. When, however, they looked at the divided space simply as cardboards, it at once became flat and unaccented. One observer said that she saw it much more impartially, looking not only at the median axis or the division line, but also around the edges and the frame. Another, when seeing it without picture associations, described her attention as following several parallel lines across the space, the division line or the central axis being no more important than the others. Another looked up and down impartially along vertical lines, never resting at the center. Several observers spoke of seeing the *edges* of the cards in the flat apperception, which they had not noticed when seeing the cards as pictures. One observer felt that her fixation for the picture apperception was at a point in the middle of the division line, behind the card, as if she were looking at a distant point, but the simple card perception meant aimless travelling along the division line over the surface and edges.

It would seem from these introspections from eleven regular observers (and essentially similar results were obtained from a

class of forty all observing at once) that a rectangular space divided into equal halves by a horizontal line, tends to be taken as flat, as free from varied associations and without strong central accent, and it has thereby very little the 'picture' character. On the other hand, the slightly unequal division lends itself to apperception of depth, and consequently to associations and to being taken as a picture. Doubtless the observers were influenced in their association by the fact that most pictures have the latter type of division, but the question still remains — Why do they?

It is interesting in this connection, that two observers liked the equal division very much, but did not want it *framed*. That is, their attention not being bound to a central point, wandered at large over the surface, and felt cramped by the frame. This suggests a possible reason why we do not, as a matter of fact, frame geometrical designs, however satisfactory they may be in themselves. In geometric designs, which are usually strongly symmetrical, both bilaterally and vertically, however much a central point may be indicated, we do not take it as a center of *interest*. Our attention is more or less impartial, it extends with equal interest to the edges, and is better satisfied by a repetition of itself than by a frame. Its out-going activity demands continuance of its design, while the in-going tendency of the picture requires exactly the reverse.[1]

[1] The MS. of this article was received June 30, 1907.—ED.

LOGICAL COMMUNITY AND THE DIFFERENCE OF DISCERNIBLES.

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In certain of our discussions[1] we have reached positions which involve the recognition of the intent of judgment to hold for more than one individual. We have given to this aspect of meaning the name of 'community.' We may now gather together the positions taken up in various connections, and show certain of their larger bearings.

1. In the first place, it appears that the process ordinarily known as generalization in logic is one in which a common meaning arises, that is, a meaning in community. The general meaning not only applies to each of the particulars under it, but it also holds for different individuals. The general-particular relationship remains the same whether the different cases that serve as particulars be observed by one individual or by many. This case is the one covered in logic by the theory of 'extension.' Certain variations upon it arise when we take explicitly the point of view of the community of the meaning.

2. Second, we find certain peculiarities attaching to the meaning rendered as 'singular.' When only one object is meant, such an object can be made subject-matter of judgment only from the point of view of community, not from the point of view of the extension of the objective class — although this is the construction given it by formal logic, which considers it a universal of a class of one! A single object can be generalized only from the point of view of the process that in some manner distinguishes in it different instances or particulars. This occurs in two ways, both of which show the absolute necessity of recognizing the character of community in logic.

[1] In *Thought and Things*, or *Genetic Logic*, Vol. II., "Experimental Logic," of which this article constitutes a section (in Chap. xiv.).

The first of these is that in which the *one single object is actually experienced by different persons*, as for instance, the 'falling' of a star. If we disregard those aspects of meaning wherein the single object may also be one of a class — then there is left over only that aspect wherein it is a single object to different persons. We have elsewhere shown how by processes of 'secondary conversion'[1] between different minds this meaning arises. The point to consider here is this: such a meaning can become logical — in the sense of having different cases to serve as basis of generalization — only if different experiences of one object can play the rôle of experiences of different objects: that is, only *if community of experience takes the place of extensive quantity*. The experiences of different minds furnish the differences which become particulars under a general. The identity of a singular — say, for example, the identity of the shooting star seen by different observers — can be rendered in a judgment only through the generalization of the appearances to these observers, whereby the event is pronounced the same for all of them. This is a movement *in community*, or in a mode that preserves the force of community.

We may say, therefore, at this point, that, but for the aspect of community attaching to judgment, *the logical rendering of a singular would be impossible.*

The other case of the rendering of a singular, seeing its great importance, may be placed under a separate heading.

3. A third case is that of the meaning attaching to a single object when experienced *by a single person only;* in what sense can such a meaning be rendered in terms of general and particular, and so become subject-matter of judgment?

Here also it is evident that there is no general meaning in extensive quantity. The meaning is a singular because of the mark or group of marks which prevent its generalization with other objects in a class. How then can we judge such an object the same, and expect others, if and when they do experience it, to agree with us? — or not experiencing it, still to accept our report of it?

Here again we have an evident resort to community. If we

[1] See *Thought and Things*, Vol. I., Chap. iv., § 5.

consider the generalization in the instance just discussed above — that of one object seen by different observers — to proceed upon differences in experiences, the object being found identical through the *differences of its appearances* to the different observers, then the recognition of community gives us the same result here. Judgment in community renders meaning as holding *for different personal acts of judgment;* and the requirements of the case are met as well, and in precisely the same way, *when recurrent experiences of one person* are substituted for different experiences of more than one. There arises what we may well call a 'general of recurrence.' In both cases, the generalization proceeds upon the commonness of the various constructions of the meaning, whether these be experiences in one mind or in many. The process whereby the meaning of 'sameness' attaches to an object is the same whether the recurrences of the meaning thus identified as the same be in one mind or in more; for there is either actual reference,[1] or the presupposition of it, from one experience to another in both cases alike. We reach, then, the striking result that a judgment of singular identity is one that may arise by the generalization of successive experiences in one mind, and this generalization is read in community as equally valid for other minds. That is, we again come to the conclusion that a judgment of singular identity is possible on the basis of a single person's recurrent experience; and that it is a judgment in community, having the force of commonness for all thinkers alike. But for the character of community, however, such a judgment would be impossible; for there is no guarantee, apart from the intent of community, that the individual's identification of the object through recurrent experiences is socially available.

The cases now interpreted show clearly just what the intent of community really is. It is the implication, in the rendering of an identical meaning by any one person, of other persons' judgment whoever they may be. It rests upon the fact, which we have studied in detail, that such a judgment of identity is one of recurrent[2] experiences, whether the objects experienced

[1] Reference of the sort called 'conversion' in my Vol. I; see the last note above.

[2] 'Recurrent,' that is, in the general sense of duplicated or plural, not necessarily successive.

be one or many, and whether the observers is one or many. The intent of community therefore is essential to judgment and is independent of variations in the other characters, especially of variations in extension.

This result appears in an interesting light when we view the three cases mentioned in the reverse order. If we take a judgment of a single individual's recurrent experience of one object as given, we may ask what it involves besides his personal belief. The first additional element of the meaning is found to be that this person expects his judgment to be confirmed by any one else who may experience the object. That is, the community intent is one that allows the substitution of another's personal experiences for one's own, or the intercalation of that person's experience in the series of one's own as in all respects equivalent to one's own. This carries over the meaning to the case mentioned second above — that of an object experienced by different observers.

Another implication then appears. Whenever occasions arise in which a judgment of identity in recurrence fails to establish itself, the experiences are read *as different objects;* that is, a generalization in extension takes place, whether or no there actually be more objects than one. The individual remarks, 'I did not recognize you — I took you for a different man.' This is precisely the same result *as if different individuals had disagreed in their several reports of the one object.* The judgment such individuals would reach after conference is that there are two objects of the same class, and this is the result the one person reaches on the basis of recurrence. The step now taken is that whereby the single individual's treatment of recurrent experiences of one object is logically equivalent to the ordinary generalization by one or more persons of different particular objects. But this holds entirely and only within the mode of community, since objectively there is but the one object.

We here come upon a principle which may be formulated alongside a celebrated historical dictum, the 'identity, or sameness, of indiscernibles.' While usually associated with the name of Leibnitz, on account of his use of it in his theory of

'monads,' it has been formulated in somewhat different senses by various thinkers.[1] We might describe it in Hegelian terms as the principle of the 'oneness of the many,' and set over against it a principle to be called the 'difference of discernibles' or the 'manyness of the one.' In the terms of our present analysis, the 'identity of indiscernibles' means in principle that in the absence of discernible difference two or more objects are judged to be one and the same in recurrent experience. It is evident that we have here the process of individuating as one, objects which do not give experience of difference. This is, therefore, just the case we have pointed out as generalization in community and not in extension. The experiences may be anybody's or everybody's; they are rendered in a judgment of singular identity. The experiences of different objects are really equivalent to those resulting from the recurrence of one.

The same movement is capable, on our principles, of precisely the reverse reading — the reading formulated in the phrase 'difference of discernibles.' A single object is rendered, by reason of differences discerned in its several appearances, as more than one. The experience passes from that form in which a single object is found to recur to one mind, and also from that in which it appears as one to different minds, to that in which its several cases have marks of difference which forbid the individuation as one object.

The principle of 'identity of indiscernibles,' when psychologically interpreted, expresses the movement in community whereby like experiences of more than one object may yield an object identified as one; while that of the 'difference of discernibles' expresses the movement also in community whereby unlike experiences of one object may lead to its determination as more than one.[2]

[1] Leibnitz, *Monadologie*, 9, and *Nouveaux essais*, II., chap. 27, § 1 ff. For citations from other authors see Eisler, *Wörterbuch d. philos. Begriffe*, Art. *Identitatis indiscernibilium*.

[2] The epistemological bearings of these principles are reserved for treatment in the later volume. Here it may be suggested, however, that all generalization illustrates the 'identity of indiscernibles' and all singularization illustrates the 'difference of discernibles.' For generalization summarizes the

In brief, any judgment, by reason of its community of intent, may be read in any one of three ways: as meaning (1) more than one object, appearing to one person or many; (2) one object only, appearing to one person or many; or (3) one object only, appearing to one person only. The process of generalization as such, considered as a summarizing of likenesses in recurrent experience, can in nowise determine which of these three the actual meaning is to be. A paranoiac declares that everybody is persecuting him, because he generalizes recurrent experiences as all fit to excite his fear of others; he is working under the principle of 'identity of indiscernibles.' At the other extreme we may cite the individual we call 'subjective,' who sees always in our conduct, however uniformly kind, new and varied signs of change. He in turn is magnifying the 'difference of discernibles.' The actual force in any case of normal judgment is determined by the control factor, the coefficients of fact which limit the meaning. The paranoiac's constructions do not allow the control that the actual differences in his attendants' action should secure; the uniform tide of his fear obliterates these differences. Nor are those of the 'subjective' man controlled in the larger meaning of kindliness that pervades the variety of our acts. In his case, the pebbles of variety choke the tide of sameness. Both are abnormal in that the actual facts do not get in their proper work.[1]

aspects of meaning in which objects are indistinguishable or identical, and singularization fixes those aspects in which each object is discernibly different from all others. We now see that this latter process, the logical rendering of the singular, explicitly requires the intent of community, a result which shows the radical rôle played by the common or social factor in all the processes of thought.

[1] It is interesting to note that there are forms of speech in which meanings based on the recurrent appearances of objects are recognized, whether such appearances are to one person or many. Propositions in which the predicate is modified by the words 'sometimes,' 'often,' 'always,' etc., may embody this meaning. 'This woman is always vain' is a universal in appearance; it is quantified in community; just as 'women are always vain,' equivalent to 'all women are vain,' has universal quantity in extension. Propositions in 'sometimes' are particular in community (as 'this woman is sometimes vain') or in extension (as 'women are sometimes vain'), or in both (as 'some women are sometimes vain'). This sort of proposition rendering variety of appearances, which change with time and circumstance, has been said by certain logicians to have multiple quantification (see Johnson in *Mind*, 1902, on 'The Logical Calculus,' and Keynes, *Formal Logic*, sect. 70). The name is a good one, since the two aspects of

I have also found reason, in the detailed discussions from which this statement is extracted, to distinguish two modes within the meaning of community. Community 'for whom' — the intent of a judgment to hold for many individuals as for one — is correlated with community 'by whom' — the further intent to suggest that the meaning may not be universally prevalent or catholic as a fact, but may be actually held by a certain number only. It is evident that what has been said in the discussion above about generalization in community, holds, in the first instance, of community 'for whom.' The question may be asked whether the other sort of community, that of catholicity, the relative commonness of the content as actually held in different minds, has any logical rôle.

There are meanings, and of course forms of speech fitted to express them, which not only recognize the recurrence of appearances, as basis of the predication made, but also the limitation of these appearances to a restricted number of persons. For example, the propositions 'there are observations that indicate that Mars is inhabited,' and 'Mr. Lowell holds that Mars is inhabited,' have both these shades of meaning. The reference to a plurality of observers may indeed be the more emphatic element as in the proposition, 'as to the truth of evolution there is wide agreement among biologists.' Of course, every one would admit that such meanings can be expressed, it is a very different thing to say that such an intent is always present in the judgment. But if we are right in holding that a problematical shading of meaning attaches to all judgments when they are actually current; that all judgment intends personal belief, which is expressed in order to silence doubt or extend conviction; in short, that all judgment has an experimental and instrumental force — then here in this mode of community we should find its variations. Probably, as a matter of fact, the

meaning do both render quantity; but it is hard to see how the quantification due to recurrent appearances of one object can be brought under the ordinary logical doctrine of quantity in extension. If we recognize, however, the recurrent appearances of one object to one mind or more as psychologically equivalent to the recognitian of a plurality of different objects, for the purposes of generalization, then in this movement which gives what I call 'community' the additional mode of quantity arises.

majority of cultivated people, if asked whether evolution is true, would say in effect, 'yes, most of the best biologists accept it.' The ground of personal acceptance here seems to be relative prevalence and the explicit recognition of this in such a judgment as that last cited, brings out the presupposition of the mode of community 'by whom' in the simple judgment of truth. Often the conditions of the appearance of the object or event to which the proposition refers require a meaning in catholicity. 'Shooting stars are often red,' 'sea-serpents have no fins,' 'the moon is made of green cheese,' are propositions that require this presupposition. They mean to report a certain degree of prevalence of the opinion, observation, or belief, which the proposition renders, as well as to cite a number of illustrative cases or appearances. These variations in prevalence or relative catholicity constitute a further sort of quantification.

The implication made in respect to prevalence varies from the singularity of the opinion or judgment rendered as private, to the universality of an appeal, let us say, to the catholicity of 'common sense.' Between these lies the particular quantity of a proposition which renders the common judgment of a limited group.

The three modes of quantity therefore that may attach to judgments are (1) quantity in extension (as in 'men are sometimes irritable'), (2) quantity in community 'for whom' or 'community of appearance' (as in 'John is sometimes irritable') and (3) quantity in community 'by whom' or in catholicity (as in 'we all find John irritable').